CLAIMS

1. In a MOSFET transistor with a reactive metal gate electrode, a method for protecting the gate electrode from an underlying gate insulator, the method comprising:

forming a gate insulator overlying a channel region;

forming a first metal barrier overlying the gate insulator;

forming a second metal gate electrode overlying the first metal barrier; and,

establishing a gate electrode work function exclusively responsive to the second metal.

2. The method of claim 1 wherein forming a first metal barrier includes forming a first metal barrier having a thickness of less than about 5 nanometers (nm); and,

wherein forming a second metal gate electrode includes forming a second metal gate electrode having a thickness of greater than about 10 nm.

3. The method of claim 2 wherein forming a first metal barrier includes forming a first metal barrier having a thickness of greater than 1.5 nm, and less than 5 nm.

4. The method of claim 1 wherein forming a second metal gate electrode includes forming a second metal gate electrode from a material selected from the group of elementary metals including p+ poly,

n+ poly, Ta, W, Re, RuO2, Pt, Ti, Hf, Zr, Cu, V, Ir, Ni, Mn, Co, NbO, Pd, Mo, TaSiN, and Nb, and binary metals including WN, TaN, and TiN.

5. The method of claim 1 wherein forming a gate insulator overlying a channel region includes forming a gate insulator from a material selected from the group including SiO_2, high-k dielectrics such as HfO_2, ZrO_2, Al_2O_3, La_2O_3, HfAlOx, and HfAlON, and binary, ternary, and nitrided metal oxides.

6. The method of claim 1 wherein forming a first metal barrier includes forming the first metal barrier from a material selected from the group including binary metals such as TaN, TiN, and WN.

7. The method of claim 6 wherein forming a second metal gate electrode includes forming a second metal gate electrode having a high work function.

8. The method of claim 7 wherein forming a second metal gate electrode with a high work function includes the second metal being selected from the group including elemental metals such as Ir, Pt, Cu, Re, Ni, Mn, Co, RuO2, p+ poly, Pd, Mo, and TaSiN, and binary metals such as TaN, WN, and TiN.

9. The method of claim 6 wherein forming a second metal gate electrode includes forming a second metal gate electrode having a low work function.

10. The method of claim 9 wherein forming a second metal gate electrode with a low work function includes selecting the second metal from the group of materials including elementary metals such as Al, Nb, Hf, Zr, V, Ir, n+ poly, W, Ti, Ta, and NbO, and binary metals such as TaN, TiN, and WN.

11. The method of claim 1 wherein establishing a gate work function exclusively responsive to the second metal includes establishing a threshold voltage (V_{th}).

12. The method of claim 1 wherein forming a first barrier metal overlying the gate insulator includes the first metal barrier preventing the migration of oxygen from the gate insulator to the second metal gate electrode.

13. The method of claim 1 wherein forming a first barrier metal overlying the gate insulator includes the first metal barrier preventing the migration of B into the gate insulator from a p+ poly gate electrode.

14. A MOSFET transistor with a reactive metal gate electrode barrier, the transistor comprising:

a channel region;

a gate insulator overlying the channel region;

a first metal barrier overlying the gate insulator; and,

a second metal gate electrode overlying the first metal barrier, having a gate electrode work function exclusively responsive to the second metal.

15. The transistor of claim 14 wherein the first metal barrier has a thickness of less than about 5 nanometers (nm); and,

wherein the second metal gate electrode has a thickness of greater than about 10 nm.

16. The transistor of claim 15 wherein the first metal barrier has a thickness of greater than 1.5 nm, and less than 5 nm.

17. The transistor of claim 14 wherein the second metal gate electrode is formed from a material selected from the group of elementary metals including W, Ta, Re, RuO2, p+ poly, n+ poly, Pt, Ti, Hf, Zr, Cu, V, Ir, Ni, Mn, Co, NbO, Pd, Mo, TaSiN, and Nb, and binary metals including WN, TaN, and TiN.

18. The transistor of claim 14 wherein the gate insulator is formed from a material selected from the group including SiO2, high-k dielectrics including HfO2, ZrO2, Al2O3, La2O3, HfAlOx, and HfAlON, and binary, ternary, and nitrided metal oxides.

19. The transistor of claim 14 wherein the first metal barrier is formed from a material being selected from the group including binary metals such as TaN, TiN, and WN.

20. The transistor of claim 19 wherein the second metal gate electrode has a high work function.

21. The transistor of claim 20 wherein the second metal layer is a material selected from the group including elemental metals such as Ir, Pt, Cu, Re, Ni, Mn, Co, RuO2, p+ poly, Pd, Mo, and TaSiN, and binary metals such as TaN, WN, and TiN.

22. The transistor of claim 19 wherein the second metal gate electrode has a low work function.

23. The transistor of claim 22 wherein the second metal gate electrode is material selected from the group of materials including elementary metals such as Al, Nb, Hf, Zr, V, Ir, n+ poly, W, Ti, NbO, and Ta, and binary metals such as TaN, TiN, and WN.

24. The transistor of claim 14 wherein the transistor has a threshold voltage (V_{th}) responsive to the second metal gate electrode work function.

25. The transistor of claim 14 wherein the first barrier metal prevents the migration of oxygen from the gate insulator to the second metal gate electrode.

26. The transistor of claim 14 wherein the first barrier metal prevents the migration of B into the gate insulator from a p+ poly gate electrode.